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2022

ENERGY AUDIT REPORT
Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.)

July 2022

Prepared By:

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Acknowledgement

We are thankful to the Management and the Vice Chancellor of the Guru Ghasidas Vishwavidyalaya, Bilaspur for entrusting processes of Energy auditing with us. We thank all the participants of the auditing team especially students, faculty and non-teaching staff who took pain along with us to gather data through survey. We also thank the office staff who helped us during the document verification.

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List of Abbreviations

Word	Meaning
ECM	Energy Conservation Measure
EE	Energy Efficiency
kVA	Kilo Volt Ampere
kVAh	Kilo Volt Ampere hour
kVAr	Kilo Volt Ampere reactive
kW	Kilo Watt
kWh	Kilo Watt hour
PF	Power Factor
RH	Relative Humidity
THD	Total Harmonic Distortion
TR	Tons of Refrigerant
INR	Indian Rupees
kV	Kilo Volt
V	Volt
A	Ampere
EB	Electricity Board
m/s	Meter per seconds
m2	Meter Square
CFL	Compact Fluorescent Lamp
FTL (T-12 & T-8)	Fluorescent Tube Light
LED	Light Emitting Diodes
FY	Financial Year
HP	Horse Power

Section 1: Executive Summary

1. Executive Summary

2. Sno	Energy saving measures	Investment (Lakh Rs.)	Energy Saving Electricity (kWh/Year)	Annual Energy Cost savings (Lakh Rs.)	Payback Period (Months)
1	Replacement of Existing Ceiling Fan to Energy Efficient Fan in University Building	108.55	434200	26.052	50
2	Replacement of Existing FTL Light to LED Light in University Building	9.5	167855	10.07	12
3	Replacement of Existing Metal Halide Light to LED in University Building	1.02	15513	0.94	13
4	Replacement of existing window type AC to energy efficient Inverter type split AC (BEE- 5 star Rated).	6.8	61200	3.672	22
5	Installing Airtron Energy Savers for ACs with a higher duty cycle (> 6 hrs./day)	20.37	458325	27.4995	9
	Total	**146.24**	**1137093**	**68.2335**	**25.72**

The Annual electrical energy savings (in kWh) are calculated and mentioned in the below table:

Total annual Energy savings, kWh	**1137093**
Total Investment, Rs Lakh	**146.24**
Total Monetary savings, Rs Lakh	**68.2335**
Simple Payback Period, Months	**25.72**

Section 2: Introduction

2. Introduction

2.1 About Guru Ghasidas Vishwavidyalaya, Bilaspur

Guru Ghasidas Vishwavidyalaya is a Central University of India, located in Bilaspur C.G. State, established under Central Universities Act 2009, No. 25 of 2009. Formerly called Guru Ghasidas University (GGU), established by an Act of the State Legislative Assembly, was formally inaugurated on June 16, 1983. GGU is an active member of the Association of Indian Universities and Association of Commonwealth Universities.

Situated in a socially and economically challenged area, the university is appropriately named to honour the great Satnami Saint Guru Ghasidas (born in the 17th century), who championed the cause of the downtrodden and waged a relentless struggle against all forms of social evils and injustice prevailing in the society. The University is a residential institution, having its jurisdiction spread over Bilaspur Revenue Division of the state of Chhattisgarh. It covers almost the entire spectrum of the higher education requirements of the country along with the local people. It has 32 (thirty two) University Teaching Department (UTDs) on its campus under 11 school of studies.

VISION AND MISSION

Vision

Motivated by the though & teaching of Guru Ghasidas, a great satnami sant of 18th century, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) is committed to Social empowerment Particularly of the weaker section of the Society with the help of quality higher education & Training.

The focus of the university is on offering strengthening innovative academics programs in emerging interdisciplinary areas of science, social Science & Humanities with quality assurance so as contribute to the growth of the Knowledge base of the university in particular & academic in general. The university aims to provide value-based holistic Education, which will lead to the growth & development of a community better equipped to serve mankind.

Mission:

- Providing greater access of inclusive quality higher education to all in particular to the socially & educationally underprivileged students.
- Promoting Academic excellence through the state of arts Undergraduate, Post Graduate, Doctoral programs.
- Offering equitable quality educational programs catering the current and future needs of the society, region & industry.
- Promoting Innovation in teaching, learning, and Research extension work & consultancy service.
- Extensive use of technology-enabled learning specially blended mode learning using ICT for Academic, administrative, financial, examination, and evaluation & students supports system of the university.
- Making students to serve humanity through the creation of well-rounded multi skilled & Socially Responsible global citizens in a multidisciplinary ecosystem.

2.2 Location:

Guru Ghasidas Vishwavidyalaya, Bilaspur and the GPS Coordinates of the University is **22°07'45.7"N 82°08'09.9"E.**

The installed capacity of each load is given as follows:

Table 1: Connected Load Break up

Sr. No.	Connected Load Breakup(kW)	
1	Lighting Load	233
2	Ceiling Fan	304
3	Exhaust Fan, Wall Fan & Cooler Load	53.5
4	A.C. Load	642
5	Computer Load	112
6	Projector & LED TV Load	11.8
7	Xerox & printers	17.34
8	Water Pumps	51.75
9	Fridge	20
10	Water Cooler & washing Machine Load	6.5
11	Geyser	120
12	Air Handling Unit (AHU) Load	74
Total Load		1645.9

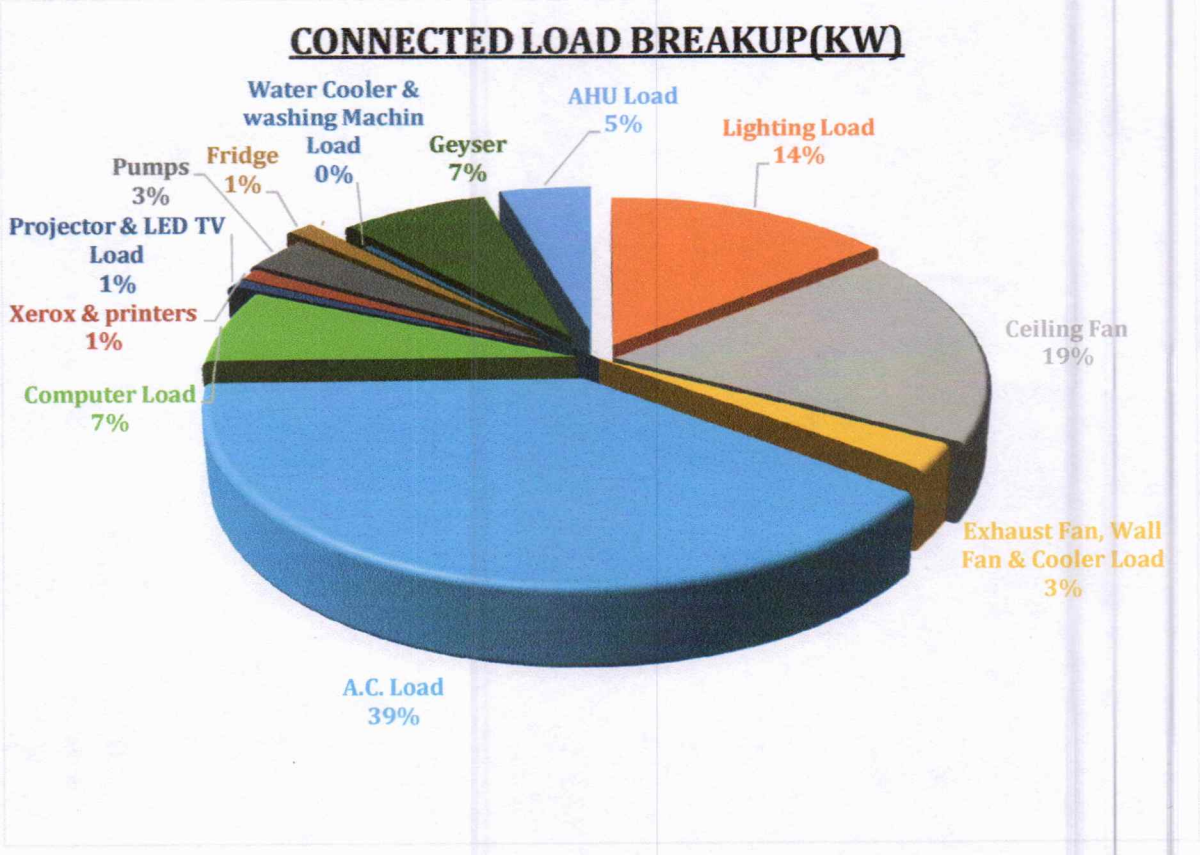


Figure 1: Connected Load Breakup

2.3 Methodology

The methodology adopted for energy audit study is given below:

- Kick off meeting
- Analysis of past performance data
- Measurements of required electrical parameters
- Conduct of efficiency and performance improvement trials (if required)
- Discussion of the findings and recommendations with Electrical Team.
- Detailed techno-economic analysis
- Report submission

2.4 Instruments used for study

The following Instruments were used during energy audit study:

Table 2: Instruments used for the study

S. No	Name of the Instrument	Make of the instrument	Details
1.	Portable power quality analyser	Hioki	Range: 5A-5000Amps Accuracy: Uncertainty in measurement is ±0.77% Voltage & ±0.7% (current), ±0.31% (watts)
2.	Thermal Imaging camera	Fluke TS10	*T*temperature Range: -10 to 350 °C (14 to 662 °F)
4.	RH meter	TESTO	Temperature range: 0°C to 50°C. with 100% RH
5.	Lux meter	Ten mars (NEDA 1604)	Range:0-2000, 0-20000 & 0-50000 Lux (3 Ranges)
6.	Digital Pressure Meter	Metravi	Range : 0 to 2.131 PSI
7.	Anemometer	Lutron (AM 4201)	Range of Velocity: 0-30 m/s
8.	Ultrasonic flow meter	ADOPT Fluid Dynamics, pune	Range: 0-2500 m^3/hr Resolution: 0.01m^3/hr

2.5 Climatic condition

The average high temperature and low temperature profile of Bilaspur is given as follows:

The hot season lasts for 2.5 months, from April 23 to July 8, with an average daily high temperature above 40.66°C. The hottest month of the year in Bilaspur is May, with an average high of 43°C and low of 30°C.

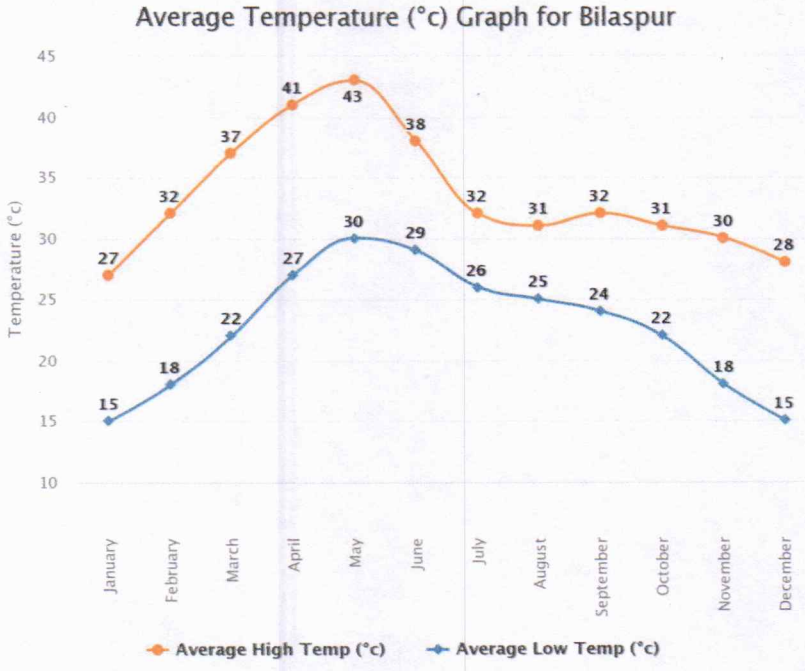


Figure 2: Climatic condition of Bilaspur

The cool season lasts for 2.6 months, from December 6 to February 23, with an average daily high temperature below 29°C. The coldest month of the year in Bilaspur is January, with an average low of 15°C and high of 27°C.

Section3: Performance Assessment

3. Performance Assessment

Guru GhasidasViswavidyalaya, Bilaspur has CommonEnergyMeterFor all Department. The facility has AC's, Fans, lighting and Computers as the major energy consuming utilities.

3.1 Load Analysis

The power logging monitoring has been done for main incomer feeder.

Main Incomer reading

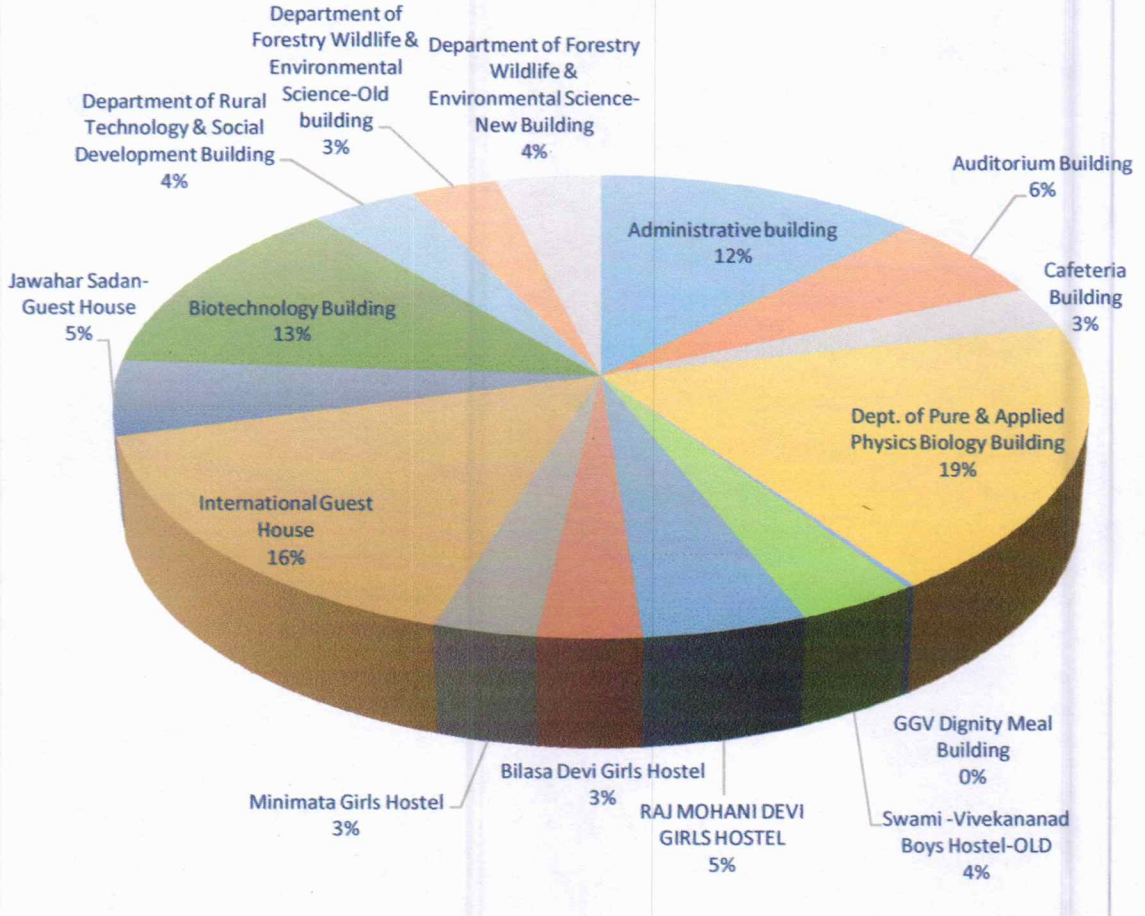
Panel Name	Voltage(V)					Current(A)					Power Factor	Power	
	RY	YB	BR	Average	Imbalan	RY	YB	BR	Average	Imbalan		kW	KVA
Main Incomer	11002	11004	11004	11003	0.01	53	53	51	52	1.27	0.892	890	997

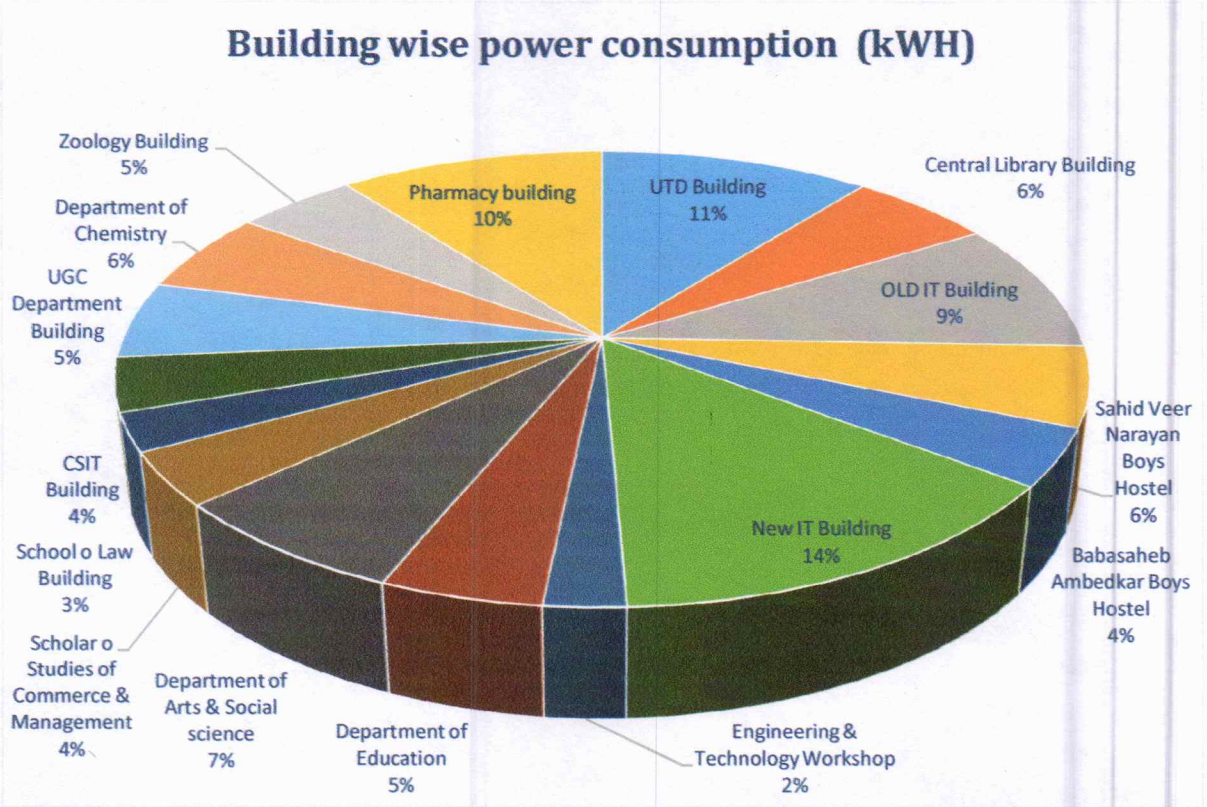
3.2 Building wise Energy Consumptions

SR. No.	Building Name	Consumption (kWh)
1	Chanayak Prashasanik Bhawan (Administrative building)	540
2	Rajat Jayanti Sabhagar (Auditorium Building)	272
3	Annapurna Cafe (Cafeteria Building)	134
4	Satyendra Nath Bose Bhawan (Dept. of Pure & Applied Physics Building)	827
5	GGV Swabhiman Thali Building	11
6	Swami -Vivekanand Boys Hostel	154
7	Raj Mohini Devi Kanya chhatrawas (Girls Hostel)	213
8	Bilasa Devi Balika Chhatrawas (New Girls Hostel – B)	133
9	Minimata Balika Chhatrawas (New Girls Hostel - A)	133
10	Samrat Samudragupt Anterrastriya Atithi Grih (International Guest House)	702
11	Jawahar Sadan- Guest House	230
12	Biotechnology Building	563
13	Department of Rural Technology & Social Development Building	176
14	Department of Forestry Wildlife & Environmental Science (Old building)	145
15	Department of Forestry Wildlife & Environmental Science (New Building)	174
16	UTD Building	411
17	Nalanda Kendriya Granthalay (Central Library Building)	218
18	OLD IT Building (First floor Central Library building)	355
19	Sahid Veer Narayan Singh Balak Chhatrawas (Boys Hostel – I)	219
20	Dr. B. R. Ambedkar Balak Chhatrawas (Boys Hostel – II)	157
21	New IT Building	535
22	Engineering & Technology Workshop	88
23	Pt. Madan Mohan Malviya Shiksha Vibhag Bhawan	176

SR. No.	Building Name	Consumption (kWh)
	(Department of Education)	
24	Dr. Shyama Prasad Mukharji Kala and Samajik Vigyan Bhawan (Department of Arts & Social science)	271
25	Scholar o Studies of Commerce & Management	144
26	School of Law Building	105
27	Aryabhatt Bhawan (CSIT Building)	147
28	UGC Department Building	209
29	Nagarjuna Bhawan (Department of Chemistry)	219
30	Zoology Building	183
31	Pharmacy building	403
Total Consumption (kWh)		**8248**

Building wise power consumption (kWH)

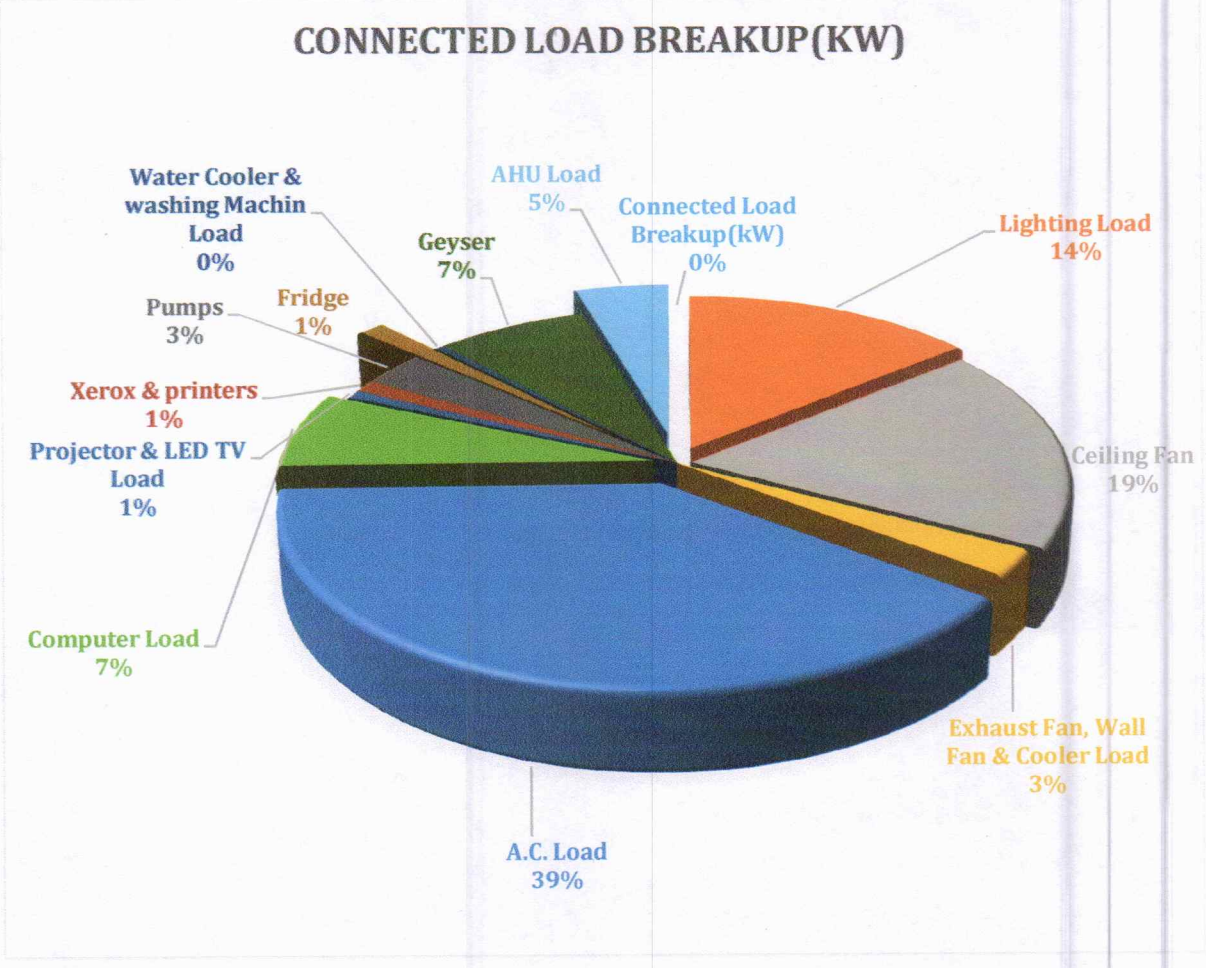




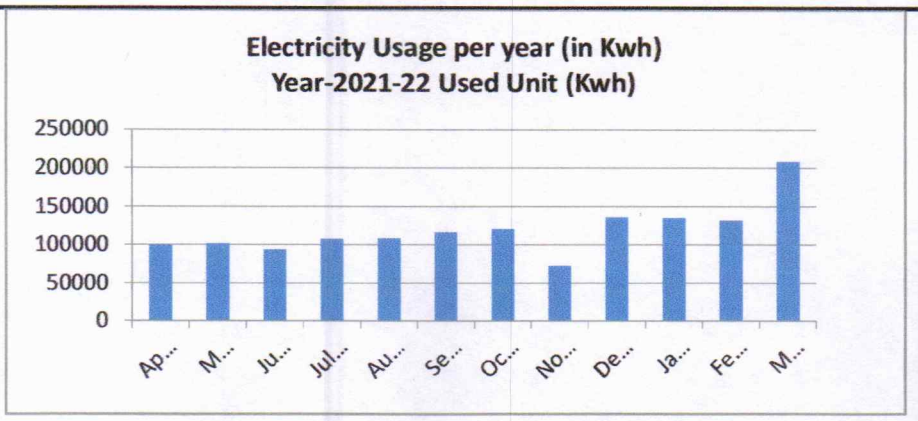
3.3 Connected Load

SR. No.	Fittings	Wattage	Total Nos.	Total wattage(kW)
1	LED-Panel Light-36W	36	141	5.1
2	LED-T-5-20 W	20	3642	72.8
3	LED-10W	10	266	2.7
4	LED Bulb-9W	9	10	0.1
5	LED-15 W	15	332	5.0
6	LED-150W	150	26	3.9
7	T-8-36W	36	3669	132.1
8	T-12- 48W	48	50	2.4
9	18 CFL	18	16	0.3
10	250W MH (Metal Hallide)	250	34	8.5
11	Ceiling fan-70W	70	4342	303.9
12	Wall Fan-65W	65	87	5.7
13	Cooler-250W	250	116	42.5
14	Exhaust Fan-65W	65	84	5.5
15	PC (Desktop Computers)	120	931	111.7
16	Printer	110	134	14.7
17	Xerox	260	10	2.6

SR. No.	Fittings	Wattage	Total Nos.	Total wattage(kW)
18	Split AC-1.5 T	1800	291	523.8
19	Window AC-1.5 T	1800	17	30.6
20	Cassette AC	3000	6	18.0
24	AC 8.5T	10000	7	70.0
21	Fridge	500	40	20.0
22	Projector	350	24	8.4
23	LED TV	200	17	3.4
25	AHU 18.5 kW	18500	4	74.0
26	Water Cooler	400	15	6.0
27	Gyser-2kW	2000	60	120.0
28	Washing Machine	500	1	0.5
29	1 HP water Pumps	750	30	22.5
30	1.5 HP water Pumps	1125	26	29.3
Total				**1645.9**



3.4 Electricity Usage per Year (in Kilowatt hour)



Electricity Usage (Kwh) in Guru Ghasidas VishwavidyalayaCampus, Bilaspur Chhattisgarh

Total Electricity uses in GGV Bilaspur campus year 2021-22

Electricity Usage per year (in Kwh)Year-2021-22	
Month	**Used Unit (Kwh)**
Apr-21	99989
May-21	101369
Jun-21	93449
Jul-21	106652
Aug-21	108899
Sep-21	116105
Oct-21	119920
Nov-21	72406
Dec-21	135968
Jan-22	135326
Feb-22	131253
Mar-22	207668
Total	**1429004**

3.5 Renewable Energy Sources

Ratio of renewable energy production divided by total energy usage per year			
S.No.	**Conventional energy usage (Kwh)**	**Reneable energy production(Kwh)**	**Ratio**
1	1429004	3010399.2	2.1

Description:

The total electricity usage of Guru Ghasidas Vishwavidyalaya Campus during 2021-2022 was 1429004 Kwh. The University utilizes the demanded electricity on research, lighting, cooling, laboratory appliances, and digital appliances. Recent year the university installed a renewable energy (solar panels) with annual production of 3010399.2 Kwh to meet increasing demand of energy for sustainable development.

22°07'36.2"N 82°08'21.6"E
Solar Roof Top Panels in Guru Ghasidas Vishwavidyalaya Buildings

S.No-3

Renewable energy sources at GGV Bilaspur campus						
S.No	Items	Location	Capacity	Nos	Total watt	Production Capacity (Kwh per year)
1	Solar street light	Various Department, Parking, Street	12W	70	840 W	3679.2
2	Roof top Solar Power Project 2MW (DC)	Various Roof of the at GGV Buildings	2 MW (DC) & 1.79 MW (AC) Approx	2MW (DC)	2 MW (DC),1.79 MW (AC) Approx	1.6MW (DC) /1.43 MW (AC)

Note:- 2MW roof top on-grid solar power plant (1.79MW AC)
Order no- 227/Engg/CPSU/GGV/2019 Dated 06.12.2019

University Engineer
Guru Ghasidas Vishwavidyalaya
Bilaspur (C.G.)

S.No- 4

Total Electricity uses in GGV Bilaspur campus year 2021-22

Electricity Usase per year (in Kwh)Year-2021-22	
Month	Used Unit (Kwh)
Apr-21	99989
May-21	101369
Jun-21	93449
Jul-21	106652
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Mar-22	207668
Total	1429004

University Engineer
Guru Ghasidas Vishwavidyalaya
Bilaspur (C.G.)

Section 4: Energy Conservation Measures (ECM)

4. Energy Conservation Measures (ECM)

ECM 1: Replacement of Existing Ceiling Fan to Energy Efficient BLDC Fan in University Building.

Replacement of Conventional Fans of 70 Watt by Energy Efficient Fans of 30 watt:

A BLDC fan takes in AC voltage and internally converts it into DC using SMPS.

The main difference between BLDC and ordinary DC fans is the commutation method. A commutation is basically the technique of changing the direction of current in the motor for the rotational movement. In a BLDC motor, as there are no brushes so the commutation is done by the driving algorithm in the Electronics. The main advantage is that over a period of time, due to mechanical contact in a brushed motor the commutators can undergo wear and tear, this thing is eliminated in BLDC Motor making the motor more rugged for long-term use.

Figure 15: BLDC motor of Energy Efficient fan

To explain, BLDC technology in simpler terms, BLDC uses a combination of Permanent Magnets and Electronics to achieve the kind of efficiency and performance it delivers. A BLDC fan composes of 3 main components:

1.Stator 2. Rotor 3. Electronics.

Figure 16: Inside view of BLDC motor

The electronics contains a driving algorithm which drives the BLDC motor. As discussed earlier in a BLDC motor the position of magnets in the fan is sensed by electronics that either uses a Hall effect sensor or back EMF. Modern BLDC motors use Back EMF for commutation due to proven disadvantages of hall effect sensor over period of time.

To explain it in easier terms, we can take an example of a donkey who has a carrot fixed over his head as per shown in the picture below:

Consider the Stator to be the Carrot and the donkey to be the Magnets. The polarity of the stator will keep changing, due to attraction the magnets will create rotational moment, just like how the donkey tries hard to reach the carrot in the picture.

Permanent magnets used in rotor are responsible for mass reduction in power consumption compared to windings used in the stator in an ordinary induction fan. One added advantage in a BLDC fans due to use of an electronic circuit is that you can add several additional features to increase convenience, few example of the same are sleep mode, timer mode also it is compatible with Home automation systems. Most of the BLDC Ceiling fans are operated by remote unlike traditional regulator reducing the purchase cost of regulator.

Compared to regular induction fan, a BLDC fan can save upto Rs 1000-1500/ Year/fan. And because there is no heating of the motor, the life of a BLDC fan is also expected to be much higher than ordinary

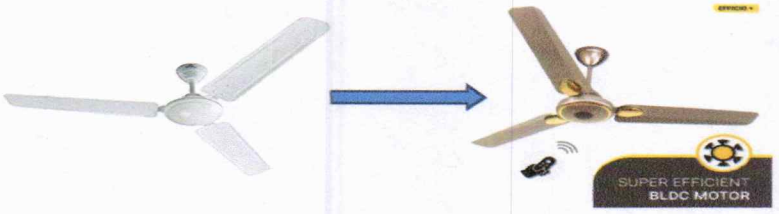
Energy Consumption: Ordinary Fans Vs BLDC Fans

Tag Name	Wattage	Daily Electricity Consumption
Regular Fan	75 Watts	1.125 units
BLDC Fan	**30 Watts**	0.45 units

Saving Calculation

Name of Particulars	Quantity	Total Wattage	Annual Operational Hours (10hr / D)	Total Unit Consumption (kWH)
Ceiling Fan (1400 mm), 70 W	**4342**	**303940**	**2500**	**759850**
Saving Calculation				
Operating days per years				250 Days
Total Annual Energy Consumption (kWh) of old CF				759850
Proposed Total BLDC Fan (30W) Energy Consumption (kWh)				**325650**
Saving due to installation of BLDC Fan -kWh				**434200**
Total Monitory Saving considering Rs.6 @ per kWh				**26,05,200**
Total Investment of installing 4342 nos. BLDC Fan @ Rs. 2500 per Fan				**1,08,55,000**
Simple Payback period in Months				**50**

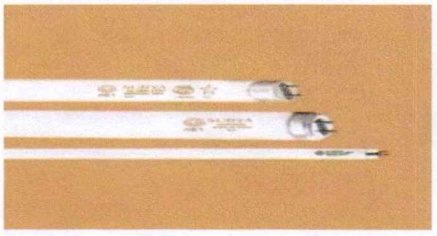
These existing Fan can be replaced in a phase manner.

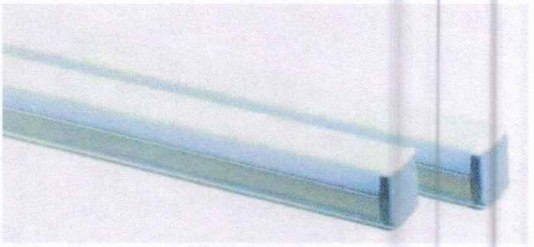


ECM 2: Replacement of Existing Ceiling FTL Light to LED in University Building.

By Installation of Energy Efficient Lighting T5 LED Tube light in place of 50, Nos. conventional T-12(40W) tube lights, 3669 nos. conventional T-8 (36W) tube lights in university campus, these existing lights can be replaced in a phase manner.

	Conventional FTL	LED T5 Lamp
Power Consumption	T-12 –40 W – 50Nos. T-8 – 36 W – 3669 Nos.	18 W- T-5- LED
	CFL - 18 W - 16 Nos.	9 W LED Bulb
Efficacy	68 lum/W	104 lum/W
Life hours	5000	20000





Power Saving	=	(((40 – 18)x50)+((36 – 18)x3669)) = 67.142kW
Annual Power Saving	=	67.142 kWx10Hr. x 250Days
	=	167855 kWh
Annual Cost Saving	=	167855kWh x Rs. 6
(@ Rs.6/Unit)	=	Rs. 10.07Lacs.
Investment (@ Rs.250 /T-5 LED)	=	Rs. 9.50 Lakh(LS)
Simple Payback Period	=	12 Months. (LS)

ECM 3: Replacement of Existing Metal Halide Light to LED in University Building.

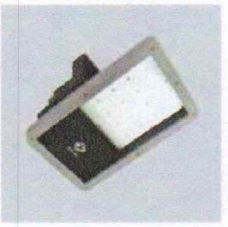
By installation of Energy Efficient LED Lighting in place of conventional MV High Bay Lights in, Campus, these existing lights can be replaced in a phase manner.

Particulates	Conventional MH High-bay &Surface Mounted Lights	HIGH BAY LED LIGHTS
Power Consumption	250 Watt - 34 Nos.	125 W
Efficacy	90 lum/W	104 lum/W
Life hours	10000	20000

FORCEBAY

169857	BJHFL 80W LED	1	11000
169858	BJHFL 100W LED	1	12500
169859	BJHFL 120W LED	1	13500
169860	BJHFL 150W LED	1	14500

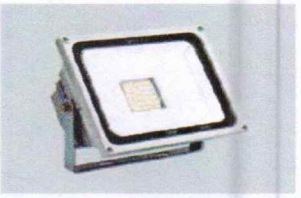
User friendly and reliable solution suitable for multipurpose applications in the industry segment. IP66 protection.



'MAGNUM' floodlights

112716	BJFL 30W LED	2	3000
112717	BJFL 60W LED	1	6000

LED Floodlight Luminaire with high pressure die cast housing and IP65 Protection.



Power Saving = (250–125) x 34 =4.25 kW

Annual Energy Saving = 4.25 x10 x 365 day
= 15513 kWh

Annual Cost Saving = 15513 x6

(@ Rs.6/Unit) = Rs. 0.94Lac.

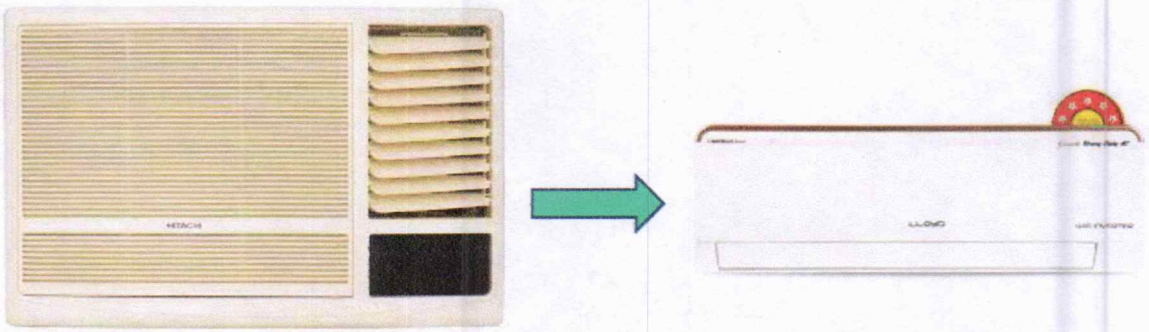
Investment = Rs. 1.02 Lac. (Rs. 3000/-)

Pay back = 13 Months.

ECM 4: Replacement of existing window type AC to energy efficient Inverter type split AC (BEE- 5 star Rated).

Saving Calculation for Single AC

Name of Particulars	wattage	Quantity	Annual Operational Hours	Values
1.5 TR window AC,Make - Blue Star	2500	17	3000	-
Existing Power Consumption of window AC (kW)				2.5
Existing Annual kWh Consumption				127500
Proposed Power Consumption of Split AC (kW)				1.3
Proposed Annual kWh Consumption				66300
Saving due to installation of New energy efficient Inverter type split AC (kWh)				61200
Total Monitory Saving considering Rs. @ 6 per kWh				367200
Total Investment of New energy efficient Inverter type split AC @ Rs. 40000/-				680000
Simple Payback period in Months				22

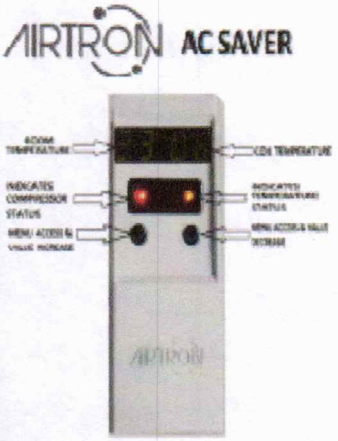


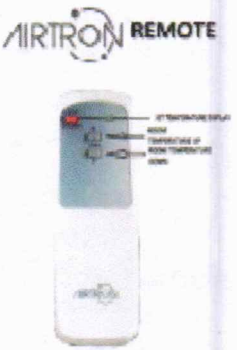
ECM 5: Installing Airtron Energy Savers for ACs with a higher duty cycle (> 6 hrs./day)

How it Works?

ACs are only controlled by mechanical relays & timers and there is no "intelligence". AIRTRON (Patented Technology) is an Intelligent microprocessor and its dual sensors reference the Room ,Coil & Ambient Temp, and uses complex, multiple algorithms in a " closed -loop circuit" to reduce the Compressor run-Time ,to ensure the high savings while maintaining and displaying the Set Temp. accurately.

No compromise on comfort as Airtron allows you to program your AC to climate and geographical locations & automatically itself to change ambient conditions to save electricity. It comes with Remote where you can set your own room Temp.

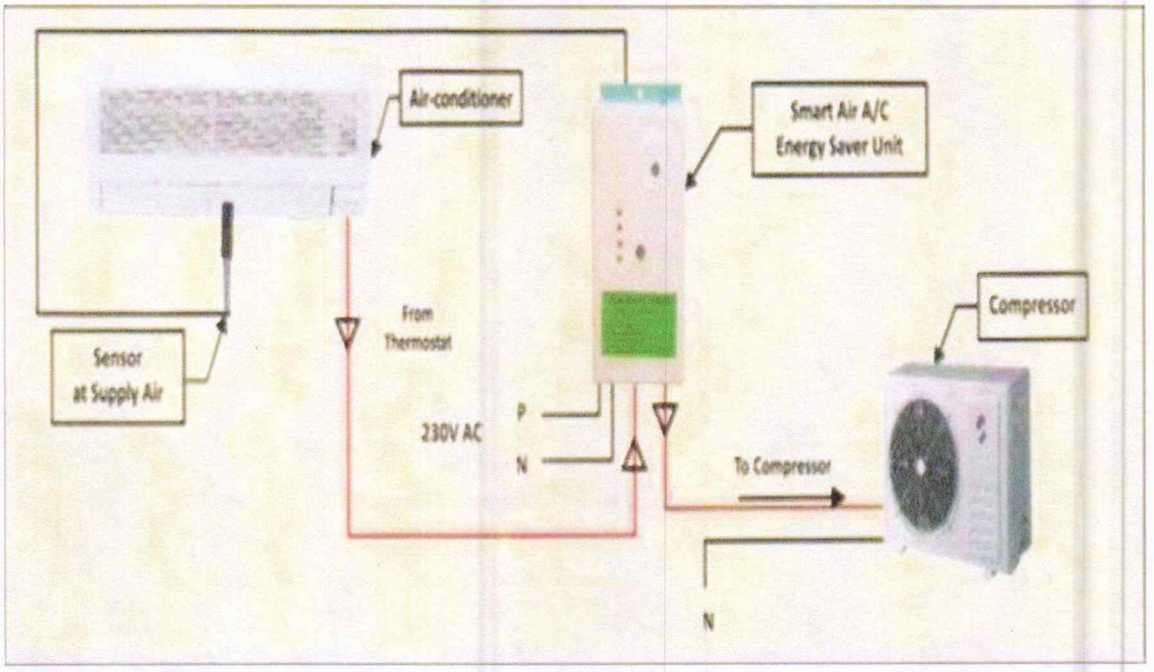




Compatible with all kind of window, Split , Inverter ACs , Package & Duct-able Air conditioners .

- Airtron is programmable and automatically adjusts to changes in climate and ambient conditions and is offered with a remote for your maximum comfort
- Airtron is the world's most advanced AC SAVER can cut your AC bills up to 35%, It is easy to install and easy to use!!! Enjoy savings for many years to come.
- Airtron received the National Award for Energy Innovation from CII -GBC 2018 (- the nodal agency in India for sustainable solutions and policy.).
- Airtron gives you a payback of 4-6 months
- Now Available in 60 countries and pan-India. Business partners wanted globally and in India - sales@magnatron.in

Eligible for claiming 40 % Depreciation in IT under "Energy saving devices"



Saving Calculation for Single Unit

Name of Particulars	wattage	Quantity	Annual Operational Hours	Total Unit Consumption (kWH)
2 TR Split	2100	291	3000	1833300
Saving Calculation				
Saving due to installation of Airtron Energy Saver@ 25% kWh				458325
Total Monitory Saving considering Rs. @ 6 per kWh				2749950
Total Investment for energy saver @ Rs. 7000 per Airtron				2037000
Simple Payback period in Months				9

5. CONCLUDING REMARKS

A well implemented energy audit is a foundation for an efficient upgrade of an energy management system, which is a tool for continued increase of energy efficiency and cost reduction.

The energy audit conducted at Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) which revealed that GGV is doing good work up to some extent while maintaining the sustainable energy system as per standard norms. In house solar power plant is installed and found to be generating power more than the demand from electricity board. Therefore the institute is going to be sustainable in energy consumption. To further reduce energy consumption GGV should implement the energy conservation measures as recommendations made in this report.

CERTIFICATION

This is to certify that Guru Ghasidas Vishwavidyalaya Bilaspur has successfully undergone **Energy audit** and assessed the Electrical Energy Conservation, Energy Saving Measures and sustainability in compliance with the applicable regulations, policies and standards for education in the campus. It is also certified that: -

i. The data collection has been carried out diligently and truthfully.

ii. All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorized and no tampering of such device has occurred.

iii. All reasonable professional skill, care and diligence had been taken in preparing the Green & Environment Audit Report and the contents thereof are a true representation of the facts.

iv. Adequate training provided to personnel involved in daily operation after implementation of recommendation.

Signature: Rahul 18/07/2022

Certified Energy Auditor ★ EA-20984 BEE ★ Rahul Agrawal

Name of the Certified Energy Auditor: Mr. Rahul Agrawal

Certification Detail: EA-20984